

Chemistry 114

1. Which is the correct order of the first ionization energies of the elements Li \rightarrow Ne?

- A) Li < Be < B < C < N < O < F < Ne
B) Ne < F < O < N < C < B < Be < Li
C) Li < B < Be < C < O < N < F < Ne
D) Li < Be < B < C < O < N < F < Ne
E) Ne < F < N < O < C < Be < B < Li

2. What volume of O₂ is required for the complete combustion of 15.0 L of ethane, C₂H₆ (g), if all gases are measured at the same T and P?



- A) 52.5 L
B) 30.5 L
C) 15.0 L
D) 14.0 L
E) 7.00 L

3. A gas sample is composed of 2.0 moles of O₂, 1.5 moles of Ar and 4.0 moles of N₂ and is contained in a volume of 837 L at 298 K. What is the mole fraction of Ar in the sample?

- A) 0.10 B) 0.15 C) 0.20 D) 0.27 E) 0.53

4. An atom of the element bromine, which has the isotopic symbol $^{81}_{35}\text{Br}$, contains how many protons, neutrons, and electrons?

- A) 81 p, 35 n, 81 e
B) 35 p, 46 n, 35 e
C) 46 p, 81 n, 81 e
D) 35 p, 46 n, 81 e
E) 35 p, 81 n, 35 e

5. Neutral atoms with the ground state outer electron configuration ns^2np^1 belong to the group with elements

- A) Sc, Y, La
B) Cu, Ag, Au
C) B, Al, Ga, In, Tl
D) Li, Na, K, Rb, Cs
E) None of the above

6. In the van der Waals equation of state for imperfect gases,

$$[P + (n^2a/V^2)][V-nb] = nRT$$

the symbol b can be approximately equated with

- A) the dipole moment of the gas molecule
- B) the intrinsic volume of one mole of molecules of the gas
- C) that portion of the total volume which is not occupied by the gas molecules
- D) the attractive forces between the gas molecules
- E) none of the above

()

7. On the basis of electronegativity, the atoms of which pair of elements would form the MOST polar chemical bond?

- A) C, F B) C, C C) O, F D) B, F E) N, F

()

8. Which of the following numbers has three significant digits?

- A) 600.03
- B) 0.66
- C) 0.066
- D) 0.0666
- E) 6.060×10^{-3}

()

9. Arrange the following isoelectronic ions in the order of decreasing (largest \rightarrow smallest) ionic radius: Na^+ , Al^{3+} , O^{2-} .

- A) Na^+ , Al^{3+} , O^{2-}
- B) Na^+ , O^{2-} , Al^{3+}
- C) Al^{3+} , Na^+ , O^{2-}
- D) O^{2-} , Al^{3+} , Na^+
- E) O^{2-} , Na^+ , Al^{3+}

()

10. How many different values of the angular momentum quantum number l are possible when the principal quantum number $n = 4$?

- A) five B) four C) three D) two E) one

()

11. Atom A has 3 electrons in its valance shell and atom B has 7 electrons in its valence shell. The formula expected for an ionic compound of A and B is:

A) A_7B_3 B) A_2B C) A_3B D) A_2B_3 E) AB_3

()

12. Which of the following sets of quantum numbers are impossible for an electron in an atom?

	n	<i>l</i>	m_l	m_s
I	4	2	0	+1/2
II	3	3	-3	-1/2
III	2	0	1	+1/2
IV	4	3	0	+1/2
V	3	2	-2	-1

- A) V is impossible, all the rest are allowed
 B) IV is impossible, all the rest are allowed
 C) II, III, and V are impossible, all the rest are allowed
 D) I, II, III are impossible, all the rest are allowed
 E) II and V are impossible, all the rest are allowed

()

13. The heat energy required to raise the temperature of one gram of a substance one kelvin at constant pressure is the

- A) specific heat
 B) molar heat capacity
 C) heat capacity
 D) enthalpy
 E) none of the above

()

14. How many hydrogen atoms are present in 3.41 g of NH_3 ?

- A) 4.83×10^{23}
 B) 3.62×10^{23}
 C) 2.89×10^{23}
 D) 2.41×10^{23}
 E) 1.21×10^{23}

()

15. Which of the following atoms or ions is paramagnetic in its ground state?

- A) Na^+ B) Kr C) Be D) Br^- E) C

()

16. The gas law represented by $V = (\text{a constant}) \times T$ at constant P is:

- A) Avogadro's law
B) Dalton's law
C) Charles' law
D) Boyle's law
E) de Broglie's law

()

17. A sample of an oxide of vanadium weighing 2.909 g was heated with H_2 (g) until only 1.979 g of vanadium (at. number = 23) metal remained. What is the empirical formula of the oxide?

- A) V_2O_3
B) VO_3
C) VO_2
D) VO
E) not enough information is given to solve the problem.

()

18. What is the partial pressure of H_2 in mm Hg (torr), if 16 g of O_2 and 2.0 g of H_2 are mixed at 25.0°C in a container to give a total pressure of 600 mm Hg?

- A) 66.7 B) 100 C) 200 D) 300 **(E) 400**

()

19. Ethane, C_2H_6 , reacts with Br_2 to form bromoethane, $\text{C}_2\text{H}_5\text{Br}$ and HBr. If 10.0 g of C_2H_6 and 10.0 g of Br_2 are used, which reactant is in excess, and how much of it remains after the reaction is complete?

- A) C_2H_6 , 1.90 g
(B) C_2H_6 , 8.12 g
C) Br_2 , 1.90 g
D) Br_2 , 8.12 g
E) Neither reactant is in excess.

()

20. The wavelength (λ) and energy (E) of a photon of red light, which has a frequency of $4.4 \times 10^{14} \text{ s}^{-1}$, are:

- ☒ A) $\lambda = 6.8 \times 10^{-7} \text{ m}$ and $E = 2.9 \times 10^{-19} \text{ J}$
☐ B) $\lambda = 6.8 \times 10^{-5} \text{ m}$ and $E = 2.0 \times 10^{-25} \text{ J}$
☐ C) $\lambda = 6.1 \times 10^{-7} \text{ m}$ and $E = 3.3 \times 10^{-19} \text{ J}$
☐ D) $\lambda = 1.5 \times 10^6 \text{ m}$ and $E = 1.3 \times 10^{-19} \text{ J}$
☐ E) $\lambda = 6.8 \times 10^{-7} \text{ m}$ and $E = 4.5 \times 10^{-40} \text{ J}$

21. A 3.05 g sample of an alloy of gold (Au) and copper (Cu) is reacted with excess nitric acid (HNO_3) to form 4.00 g of copper (II) nitrate ($\text{Cu}(\text{NO}_3)_2$). The gold does not react. The percentage, by mass, of Au in the alloy is

- ☐ A) 11.9% ☐ B) 33.6% ☒ C) 44.4% ☐ D) 55.6% ☐ E) none of these

22. You are provided with 400 mL of a 0.234 M solution of NaCl. You are asked to make a 0.100 M solution of NaCl. Assuming that the liquid volumes are additive, how many mL of water are you to add to the original solution?

- ☐ A) 936 mL ☒ B) 536 mL ☐ C) 436 mL ☐ D) 334 mL ☐ E) 234 mL

23. How many grams of KIO_3 are needed to prepare 500.0 mL of a 0.0100 M solution of KIO_3 ?

- ☐ A) 10.7 g
☐ B) 4.28 g
☐ C) 2.14 g
☒ D) 1.07 g
☐ E) $2.34 \times 10^{-3} \text{ g}$

24. The element gallium has two naturally occurring isotopes that have the following relative atomic masses: $^{69}\text{Ga} = 68.9257$ and $^{71}\text{Ga} = 70.9249$. If the average mass of the naturally occurring mixture of isotopes is 69.723, what is the fractional abundance of ^{69}Ga ?

- ☐ A) 0.704 ☒ B) 0.601 ☐ C) 0.499 ☐ D) 0.399 ☐ E) none of these

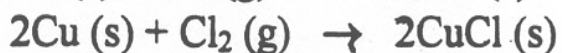
25. Calculate the value of ΔH° for the reaction



Given the information



$$\Delta H^\circ = -206 \text{ kJ mol}^{-1}$$



$$\Delta H^\circ = -36 \text{ kJ mol}^{-1}$$

- A) $+134 \text{ kJ mol}^{-1}$
- B) $+242 \text{ kJ mol}^{-1}$
- C) -242 kJ mol^{-1}
- D) -170 kJ mol^{-1}
- ☒ E) $+170 \text{ kJ mol}^{-1}$